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REVIEWS OF BOOKS.

The Concept of Nature. Tanner Lectures delivered in Trinity College, November, 1919. By A. N. WHITEHEAD. The University Press, Cambridge. 1920.—pp. viii, 202.

This book is a welcome sequel to the author's *Enquiry concerning the Principles of Natural Knowledge,* and it goes far toward realising the ideal of a comprehensive philosophy of nature. The electromagnetic theory of relativity, which has met with such a favorable reception among the physicists and mathematicians, certainly involves a new philosophy of nature, but most of the students of that theory have naturally been more interested in the scientific revolution it carries with it, than in its philosophical implications. It is fortunate that a person so well equipped from the side of mathematics and physics as Professor Whitehead is, should set himself the task of working out the philosophy of nature required by the theory. Professor Whitehead has evidently read widely and profoundly in recent philosophy, and the results are seen in almost every page of this work. It is therefore inevitable that a book from such an author, who comes as near as it is possible to come to combining knowledge of scientific detail with that of mathematical and philosophical theory, should be of the greatest importance. Whether the view he presents proves to be ultimately acceptable or not, it will form the starting point for subsequent labors in the field, and in this sense, the work is epoch-making.

Such a work is impossible to outline in a short review. I shall therefore not attempt to give to those who have not read it an idea of what it contains. I shall rather pick out some points for discussion, assuming that those who read this review have already read the book.

Professor Whitehead frankly declines to go into the metaphysical aspects of the problem, and he does not discuss epistemological questions. He merely assumes the existence of knowledge, as indeed he has the right to do, without inquiring why knowledge should be. In fact, he says that the question as to the why of knowledge is insoluble —this is of course an epistemological position; but it is not argued. He says: "We are endeavoring in these lectures to limit ourselves to nature itself, and not to travel beyond entities which are disclosed in sense-awareness. Percipience itself is taken for granted. We consider indeed conditions for percipience, but only so far as those conditions are among the disclosures of perception. We leave to metaphysics the synthesis of the knower and the known. . . . The immediate thesis for discussion is that any metaphysical interpretation is an illegitimate importation into the philosophy of natural science. By a metaphysical interpretation I mean any discussion of the how (beyond nature) and of the why (beyond nature) of thought and sense-awareness. In the philosophy of science we seek the general notions which apply to nature, namely, to what we are aware of in perception. It is the philosophy of the thing perceived, and it should not be confused with the metaphysics of reality of which the scope embraces both perceiver and perceived. No perplexity concerning the object of knowledge can be solved by saying that there is a mind knowing it. . . . The recourse to metaphysics is like throwing a match into a powder magazine. It blows up the whole arena. This is exactly what scientific philosophers do when they are driven into a corner and convicted of incoherence. For natural philosophy everything perceived is in nature. We may not pick and choose. For us the red glow of the sunset should be as much part of nature as are the molecules and electric waves by which men of science would explain the phenomena. It is for natural philosophy to analyse how these various elements of nature are connected. In making this demand I conceive myself as adopting our immediate instinctive attitude towards perceptual knowledge which is only abandoned under influence of theory. We are instinctively willing to believe that by due attention, more can be found in nature than that which is observed at first sight. But we will not be content with less. What we ask from the philosophy of science is some account of the coherence of things perceptively known. This means a refusal to countenance any theory of psychic additions to the object known in perception. For example, what is given in perception is the green grass. This is an object which we know as an ingredient in nature. The theory of psychic additions would treat the greenness as a psychic addition furnished by the perceiving mind, and would leave to nature merely the molecules and the radiant energy which influence the mind towards that perception. . . . What I am essentially protesting against is the bifurcation of nature into two systems of reality, which, in so far as they are real, are real in different senses. One reality would be the entities such as electrons which are the study of speculative physics. This would be the reality which is there for knowledge; although on this theory it is never known. For what is known is the other sort of reality, which is the byplay of the mind. Thus there would be two natures, one is the conjecture, and the other is the dream" (pp. 28–30).

"Now I assume as an axiom that science is not a fairy tale. It is not engaged in decking out unknowable entities with arbitrary and fantastic properties. What then is it that science is doing, granting that it is effecting something of importance? My answer is that it is determining the character of things known, namely the character of apparent nature. But we may drop the term 'apparent'; for there is but one nature, namely, the nature which is before us in perceptual knowledge. The characters which science discerns in nature are subtle characters, not obvious at first sight. They are relations of relations and characters of characters. But for all their subtlety they are stamped with a certain simplicity which makes their consideration essential in unravelling the complex relations between characters of more perceptive insistence. The fact that the bifurcation of nature into causal and apparent components does not express what we mean by our knowledge is brought before us when we realise our thoughts in any discussion of the causes of our perceptions. For example, the fire is burning and we see a red coal. This is explained in science by radiant energy from the coal entering our eyes. But in seeking for such an explanation we are not asking what are the sort of occurrences which are fitted to cause a mind to see red. The chain of causation is entirely different. The mind is cut out altogether. The real question is, When red is found in nature, what else is found there also? Namely we are asking for an analysis of the accompaniments in nature of the discovery of red in nature. . . . the wave theory of light has not been adopted because waves are just the sort of things which ought to make a mind perceive colours. This is no part of the evidence which has ever been adduced for the wave-theory, yet on the causal theory of perception, it is really the only relevant part. In other words, science is not discussing the causes of knowledge, but the coherence of knowledge. The understanding which is sought by science is an understanding of relations within nature" (pp. 40–41).

"The primary task of a philosophy of natural science is to elucidate the concept of nature, considered as one complex fact for knowledge, to exhibit the fundamental entities and the fundamental relations between entities in terms of which all laws of nature have to be stated, and to secure that the entities and relations thus exhibited are adequate for the expression of all the relations between entities which occur in nature" (p. 46).

It would seem as if the accomplishment of this task, even in a very tentative and provisional fashion, should be welcomed as a great achievement; but doubtless many philosophers will find that the very statement of the problem involves many metaphysical assumptions. Let that be granted. A man has the right to make such assumptions, and if he does make them, and expressly recognizes that he makes them, and then proceeds to develop the consequences of such assumptions, taken in connection with the findings of fact made by the scientific explorers, he has done a big task if he has done it well. One should not cavil when another chooses to make different assumptions from one's own. For myself, it seems that Professor Whitehead's assumptions are very reasonable; indeed it would be hard to find more sense packed into a little more than twenty pages, than is to be met with in the second chapter, "Theories of the Bifurcation of Nature".

Professor Whitehead's treatment of significance also is especially satisfactory. For him the basis of significance is the "disclosure of an entity as a relatum without further specific discrimination of quality. . . . Thus significance is relatedness, but it is relatedness with the emphasis on one end only of the relation" (p. 51). According to this view, an "entity merely known as spatially related to some discerned entity is what we mean by the bare idea of 'place'", and the "concept of 'period of time' marks the disclosure in sense-awareness of entities in nature known merely by their temporal relations to discerned entities" (pp. 51–52). This is a logical use of James' 'fringe'.

According to Professor Whitehead's interpretation, "Nature is a process. As in the case of everything directly exhibited in sense-awareness, there can be no explanation of this characteristic of nature. All that can be done is to use language which may speculatively demonstrate it and also to express the relation of this factor in nature to other factors. It is an exhibition of the process of nature that each duration happens and passes. The process of nature can also be termed the passage of nature. . . the measurable time of science and of civilised life merely exhibits some aspects of the more fundamental fact of the passage of nature. . . . Also the passage of nature is exhibited equally in spatial transition as well as in temporal transition. It is in virtue of its passage that nature is always moving on" (pp. 53–54). In other words, such concepts as 'space', 'time', 'extension', as used by Whitehead, 'position' in space, 'period of time,' 'continuity', are all abstractions from the fact that nature is moving on.

These abstractions exhibit features present in that fact, and are thus not mere fairy tales; but they must not be construed as presenting separate and separable characters whose accidental union makes nature. Nature is not built up of logical elements, but logical elements are obtained by discrimination and abstraction from nature. This I take to be Professor Whitehead's fundamental contention, though perhaps he would object to the way in which I have stated it. If I am right in my understanding of him, again it seems that he is attacking his problem in the only hopeful way. There may be criticism in detail of his results, but such criticism should not imply any dissatisfaction with his starting point or his general method.

The general result that he obtains presents us with a fascinating world-view. Nature is marching on; that is, events are continuously happening. An event never happens again. There is never any reversal in this process. But an event is characterised, and the characters involved are recognised in other events. These recognisable characters are objects and relations. The irreversibility of the stream of events is the passage of nature, which we may here call the sequence of nature. In nature there are no alternative sequences. But sequence is not all that we mean by 'time'. In 'time' events not only follow other events and precede still others; but they also are simultaneous with yet others. Now while there are not alternative sequences in nature, they are alternative simultaneities. Hence, if we mean by time a system of relations which includes both sequence and simultaneities, then there is not just one time in nature. There are many times, or as Professor Whitehead calls them, many 'time-systems' or 'families of durations', a 'duration' being a slab of nature characterized by simultaneity and also exhibiting passage. Or, to use Professor Whitehead's own language, the unity of a duration "is expressed by the concept of simultaneity" (p. 53). I take that it that for him 'simultaneity' is something ultimate and unanalysable. Einstein *defines* simultaneity by assuming the constancy of the velocity of light *in vacuo,* and by using a system of light signals to synchronise clocks; and then events which happen in any two places in any system at rest are defined as simultaneous if the clock readings at these two places are identical. But Whitehead finds simultaneity as a property of certain wholes of nature, such wholes being durations.

Whitehead's definition of a family of durations need not be quoted here. The point to be noted is that durations of different families intersect; and if in each family a class or series of durations be selected with proper defining characteristics, which class he calls a moment, the locus of intersection of moments of two families is a 'level', which is the analogue, in the moment, of a plane in the timeless space of the classical tradition. Levels intersect in 'rects', the analogues of straight lines; and rects intersect in 'puncts' or 'event-particles', the analogues of points.

Every event occurs in every family of durations; but in each different family it has different simultaneous associates, taken as a whole. However, there is a sub-class of simultaneous associates which it has in either of two families of durations. Such families of associates have relations to each other which furnish the basis for our conception of a plane in timeless space. By following out this line of thought, we arrive at the conclusion that 'space' is a conceptual derivative from the fact of the passage of nature. It corresponds to an *aspect* of the passage of nature, but there is no such thing as a *merely* timeless space.

The metrical relations between the different families of durations, when we have derived 'time' and 'space' from them in their interrelations, are substantially expressed by the now famous transformation equations of the special theory of relativity. The whole discussion of this subject presupposes a four-dimensional geometry.

The very brief statement of what I take to be Whitehead's view is necessarily unintelligible, except on the supposition that the reader is fairly familiar with the text of the work under review. Whether it is a correct statement I do not dare to say; it is at least a brief statement that expresses my understanding of the text. If this understanding be correct, I am now in a position to bring forward one query the answer to which may be decisive as to the satisfactoriness of the whole view.

Does not Professor Whitehead's definition of 'position' (pp. 92 and ff.) expose him to exactly the same sort of criticism that he has himself urged with such telling force against certain views of temporal congruence (pp. 137 ff.)? There he says that the prevalent view is that if we take time-measurements "so that certain familiar velocities which seem to us to be uniform are uniform, then the laws of motion are true. . . . Suppose that with some expositors we cut out the reference to familiar velocities such as the rate of rotation of the earth. We are then driven to admit that there is no meaning in temporal congruence except that certain assumptions make the laws of motion true. Such a statement is historically false. King Alfred the

Great was ignorant of the laws of motion, but knew very well what he meant by the measurement of time, and achieved his purpose by means of burning candles. Also no one in past ages justified the use of sand in hour-glasses by saying that some centuries later interesting laws of motion would be discovered which would give meaning to the statement that the sand was emptied from the bulbs in equal times. Uniformity in change is directly perceived, and it follows that mankind perceives in nature factors from which a theory of temporal congruence can be formed. The prevalent theory entirely fails to produce such factors."

Now let us turn to Professor Whitehead's view as to the meaning of 'position'. "Position is the quality which an abstractive element possesses in virtue of the moments in which it lies. The abstractive elements which lie in the instantaneous space of a given moment *M* are differentiated from each other by the various other moments which intersect *M* so as to contain various selections of these abstractive elements. It is this differentiation of the elements which constitutes their differentiation of position" (p. 92). Cannot one say that King Alfred was ignorant of intersecting families of durations, but knew very well what he meant by the position of the camp of the Danes? No one in past ages justified the use of methods of locating position by saying that some centuries later Professor Whitehead would discover intersecting families of duration and thus would give meaning to the statement that something has such and such a position in space. Why does not Professor Whitehead's theory compel the admission that there is no meaning to position except as certain assumptions as to intersecting durations give a meaning to it? Is not such a statement historically false? Would not the natural view, on the contrary, be that position in space is directly perceived, and that it follows that mankind perceives in nature the factors from which a theory of position can be formed? Now mankind does not directly perceive the existence of different families of durations. No scientist, with all his training in powers of observation, has perceived such things. They are apparently signified by some observations made by scientists; but surely such things can hardly be the perceived factors in nature, which can give meaning to judgments of position.

If this criticism be a fair one, then it holds as well against Professor Whitehead's account of the meaning of perpendicularity, and perhaps against the way in which he takes the whole system which he constructs. It is a great accomplishment to construct a philosophy of nature which shall do justice to the facts on which the theory of relativity is based; but is it not going too far to say that such a philosophy alone can give us meanings for position, perpendicularity, timeless space, and various other concepts that we as a race have been using for centuries, before the theory of relativity was ever thought of? This criticism, if valid, would not invalidate Professor Whitehead's general theory; it would only invalidate the claim made for it that it alone, of all extant theories, gives meaning to certain current and practically justified conceptions.

I am not sure that I have understood Professor Whitehead aright. On so many points where at first I had thought I had found him wrong, I have come after study to revise my judgment. It may be that further study will necessitate a revision here. But up to the present it appears that the above criticism is justified.

The book is not easy reading. It is very difficult reading for a man who has not had much mathematical training, and perhaps most philosophers have not had much. But one of the merits of the theory of relativity is that it requires us to polish up our mathematical equipment. But so far, it seems to me that the greatest philosophical achievement of the theory of relativity is the fact that it has brought forth a work of such profound philosophical importance as *The Concept of Nature.* Every philosopher should not only read it, but study it; and when he does, he will undergo a searching of heart. The prestige of the author will secure for him many readers among men of science—they will inevitably revise their old conceptions; and from the fact that in this book philosopher and scientist will have to meet, much good will come, at least to the philosopher.

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Spiritual Pluralism and Recent Philosophy. By C. A. RICHARDSON. The University Press, Cambridge, 1919,—pp. xxi, 335.

Contemporary critics of idealism should read this book. Whatever its effect on their metaphysical theories it could not fail to enlarge their over-limited conception of idealism and to convince them that idealism is not bound to take either one of the two shapes in which they are wont to attack it, to wit, a subjectivism derived from Berkeley and an impersonal monism of the Bosanquet type.[1] And

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[1] For a recent instance of criticism of this sort, cf. S. Alexander, *Space, Time and Deity,* Vol. I, pp. 5-7.